

REMARKS

Claims 1-40 are pending in the present application. Claims 1, 12, and 17 have been amended. The specification has been amended to correct a typographical error.

Applicant respectfully requests reconsideration of the application in view of the foregoing amendments and the remarks appearing below.

Rejections Under 35 U.S.C. § 112, Second Paragraph

The Examiner has rejected claims 1-40 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention.

In particular, regarding claim 1 and similar claims, the Examiner asserts the phrase "a plurality of second manifolds formed in said core and extending substantially co-extensively, and located alternatingly across said width, with said plurality of first manifolds" is indefinite. The Examiner states it cannot be determined if this phrase means 1) a plurality of second manifolds alternates with a plurality of first manifolds and so on across the width or 2) single second manifolds alternate with single first manifolds across the width to form a plurality of first manifolds and a plurality of second manifolds across the width. Applicant respectfully disagrees.

Applicant does not understand why the phrase is indefinite. Using the ordinary meanings of the terms in the phrase, the phrase covers both alternatives the Examiner has identified. The fact that one phrase supports several alternatives does not mean that phrase is indefinite. On the contrary, Applicant specifically selected the phrase so as to not limit the scope of the claim to any one of the alternative meanings.

Those skilled in the art will readily understand that the phrase encompasses more than one arrangement of pluralities of first and second manifolds. That is, those skilled in the art will clearly recognize that all that is required for two types of things to be located alternatingly is that the types alternate with one another. For example, if one type of thing is designated "A" and the other type of thing is designated "B," then the following examples would satisfy the "alternatingly" limitation of the phrase:

A-B-A-B-A-B-A-B-A;

A-BB-A-BB-A-BB-A-B;

A-BB-AA-BB-AA-BB-A;

and so on.

In each of these examples, the "A" and "B" types of things can properly be said to be positioned "alternately" with respect to each other. Therefore, it is Applicant's position that the Examiner's distinction does not bear on whether the phrase is indefinite. The Examiner has merely identified two correct meanings of the phrase.

In addition, the Examiner asserts it is unclear what the two phrases "extending along said length" and "extending said length" mean. Applicant respectfully disagrees.

Each of these phrases has a meaning distinct from the other. In the former, when a thing, e.g., a manifold, extends along the length, this means that the thing has a longitudinal axis parallel to the length. In contrast, in the latter, when a thing extends the length, e.g., a first length, the thing extends in the direction of the first length and has a second length that is equal to or greater than the first length. Since these phrases have distinct, intended meanings that are clear upon careful reading, Applicant asserts that these phrases are not indefinite and do not require modification.

Regarding claim 17, the Examiner asserts that "said second manifold" in line 7 should be replaced with "said plurality of second manifolds" to improve clarity and readability. Applicant has amended claim 17 in the manner the Examiner suggests.

Regarding claim 40 (which the Examiner has inadvertently misidentified as claim 17), the Examiner states that there is insufficient antecedent basis for two occurrences of the phrase "said flow areas" in line 7. Applicant respectfully disagrees.

In lines 5 and 6, claim 40 states that a plurality of plates each define at least one interconnecting channel each having a flow area. Therefore, this claim requires a plurality of interconnecting channels each having a corresponding flow area. Consequently, this claim requires a plurality of flow areas. Thus, Applicant believes the plural phrase "said flow areas" is correct.

For the foregoing reasons, Applicant respectfully requests that the Examiner withdraw the various indefiniteness rejections of claims 1-40.

Rejections Under 35 U.S.C. § 102(b)**The Nguyen Patent**

The Examiner has rejected claims 1, 3-8, 10, 19, 20, 22, 24-27, 33, 35, 36, 39, and 40 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,016,707 to Nguyen, asserting Nguyen discloses a structure and method each containing all the elements of the corresponding claims. Applicant respectfully disagrees.

Nguyen discloses a multi-pass cross-flow jet-impingement heat exchanger for transferring heat from a first fluid to a second fluid flowing in a direction perpendicular to the flow direction of the first fluid. The heat exchanger is made up of a number of plates, including end plates 10, 18, manifold plates 11-13, and core plates 14, 15. Core plates 14, 15 are provided in repeating pairs each consisting of one impingement plate 14 and one spacer plate 15. Each spacer plate 15 includes relatively large openings 15a, each for receiving a portion of the first fluid therethrough and directing it to a corresponding impingement region of an adjacent impingement plate 14, or end plate 18 or manifold plate 13, as the case may be. Each impingement region includes a group of relatively small openings 14a for allowing the first fluid to pass therethrough.

Accordingly, the core of the Nguyen heat exchanger includes a plurality of parallel passageways for conducting the first fluid along a circuitous path through the core. Each of these passageways is defined by the large openings in the spacer plates 15 and corresponding groups of small openings in the impingement plates 14. The flow path of the second fluid through the passageways is defined between fins 14", 15".

Comparing the Nguyen heat exchanger to the rejected claims using claim 1 as an example, the Nguyen heat exchanger lacks several features recited in claim 1. For example, claim 1 requires a heat transfer surface, e.g., the heat transfer surface corresponding to heat transfer surface 22 shown in the prior art device of FIG. 1 of the present application, that extends along the length and width of the heat exchanger. The Nguyen heat exchanger does not have such a heat transfer surface. This is so because the Nguyen heat exchanger is a heat exchanger for exchanging heat from one fluid to another within the heat exchanger.

In addition, claim 1 also requires pluralities of first and second manifolds extending along the length of the core. The Nguyen heat exchanger does not have any manifolds extending the length of the core. Rather, the Nguyen heat exchanger has only a plurality of passageways

extending along the length of the core, i.e., the passageways formed by openings 14a and 15a in impingement and spacer plates 14 and 15, respectively. Each of these passageways cannot fairly be characterized as a manifold, since each does not fluidly communicate with a plurality of other passageways and, thus, does not satisfy the meaning of the term "manifold." Alternatively, if the length of the core is considered to extend in the direction of the flow of the second fluid, the passageways in this direction also cannot be characterized as "manifolds." They are merely passageways partially separated by fins 14" and 15". Moreover, since the flow of the second fluid through the corresponding passageways is essentially in only one direction, the passageways cannot fairly be considered to be of "first" and "second" types. Claim 1 requires "first" and "second" manifolds.

Since Nguyen does not disclose at least these features of claim 1, the Nguyen patent cannot anticipate this claim. The remaining rejected independent claims include features that are similar to the features of claim 1, so that the analyses of each of these claims with respect to the Nguyen patent is substantially the same as the analysis of claim 1. Thus, the Nguyen patent cannot anticipate any of the rejected claims. Therefore, Applicant respectfully requests that the Examiner withdraw the present rejection of claims 1, 3-8, 10, 19, 20, 22, 24-27, 33, 35, 36, 39, and 40 in view of the Nguyen patent.

The Chu et al. Patent

The Examiner has rejected claims 1-6, 9, 10, 12-14, 19-30, and 33-40 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,269,372 to Chu et al., asserting Chu et al. disclose a structure and method each containing all the elements of the corresponding claims. Applicant respectfully disagrees.

Chu et al. disclose cold plate assembly 8 for cooling an electronic module. The assembly includes a plate 10 having kerfs 14,16 formed therein so as to form a grid of such kerfs that define a plurality of blocks. In one embodiment, the blocks are square with respect to the shape formed by the intersecting kerfs. In another embodiment, the blocks are rhomboidal. The kerfs contain a cooling fluid that collects heat from the plate 10 as the fluid flows past the blocks. A blind hole is drilled at each intersection between two kerfs to form either a conduit 17 or a conduit 18.

The conduits 17 and 18 are each in fluid communication with a corresponding finger channel 170, 180, respectively, formed in a manifold plate 148 located above the kerfs and blocks. Finger channels 170, 180 are in fluid communication with corresponding supply channels 172 and return channels 178, respectively.

Regarding independent claims 1, 12, and 39, Applicant acknowledges that the kerfs of the Chu et al. device could be asserted to be the "interconnecting channels" of claims 1, 12, and 39, and the finger channels 170, 180 could be asserted to be the first and second manifolds of these claims. Even if this were done, however, Chu et al. do not disclose the specific relationship between the interconnecting channels (kerfs) and the first and second manifolds (finger channels) recited in claims 1, 12, and 39.

Each of claims 1, 12, and 39 require that the manifolds extend along the length of the core and that the interconnecting channels be spaced from one another along the length. Chu et al. do not disclose this relationship. This is so because the Chu et al. kerfs necessarily intersect with one another and are skewed relative to the finger channels. This geometry cannot satisfy the dual requirements of each of claims 1, 12, and 39 that the manifolds extend along the length of the core and that the interconnecting channels be spaced from one another along the length.

Regarding independent claims 19, 28, 33, and 36, in addition to the limitations discussed above with respect to claims 1, 12, and 39, each of independent claims 19, 28, 33, and 36 requires a plurality of plates be stacked in the direction of a stacking axis to define manifolds extending along the staking axis. Chu et al. clearly do not show this. Rather, the Chu et al. finger channels (manifolds) are in a plane perpendicular to the stacking axis. Therefore, the Chu et al. patent cannot anticipate claims 19, 28, 33, and 36 for this additional reason.

Regarding independent claim 40, this claim is directed to a method of providing a heat exchanger having a heat transfer capacity that varies over the heat transfer surface of the exchanger. This claim includes the step of forming a plurality of flow channels having different areas. Chu et al. are silent on this feature and, therefore, cannot anticipate claim 40.

For at least the foregoing reasons, the Chu et al. patent cannot anticipate claims 1-6, 9, 10, 12-14, 19-30, and 33-40. Therefore, Applicant respectfully requests that the Examiner withdraw the present anticipation rejection.

The Messina Patent

The Examiner has rejected claims 1-5, 10, and 12-16 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,309,319 to Messina, asserting Messina discloses a structure containing all the elements of these claims. Applicant respectfully disagrees.

Messina discloses an integrated cooling system 10 for cooling a plurality of electrical components 162 mounted on a circuit board 160 using a cooling liquid 20. As seen in FIG. 1 of the Messina patent, the integrated cooling system 10 includes a two-part manifold structure 102, 104 that defines a chamber that contains circuit board 160, as well as "a bath of cooling liquid 170. Col. 7, lines 65-66. Manifold part 102 has a plurality of inflow and outflow ducts 110, 120 that communicate liquid to a plurality of cooling chambers 130 via corresponding liquid supplying and removing ducts 112, 122. In one embodiment, the inflow and outflow ducts 110, 120 conduct the cooling liquid in opposite directions from one another and each chamber is supplied by one of the inflow ducts 110 and vented by two outflow ducts 120. Each cooling chamber provides cooling for a corresponding electronic component 162.

Each of independent claims 1 and 12, as amended, requires that the heat-transfer surface be external to the core. That is, the heat-transfer surface of the present invention is on the outer surface of the core, where it can be interfaced with an external heat source from which heat is to be collected by a cooling fluid within the core that flows through the first and second manifolds and interconnecting channels.

Messina simply does not disclose such an external heat transfer surface. In fact, only three embodiments of the Messina device can be said to have a heat-transfer surface that engages an electrical component 162. These are the embodiments that include at least one of the thermally conductive slug 510, the thermally conductive piston 520, or the thermally conductive layer 540. In the other embodiments, cooling liquid 20 impinges directly on the electrical components immersed in the bath of cooling liquid 170. However, even the embodiments having a heat-transfer surface, the heat transfer surface is located internally with respect to the two part manifold. This is so because the Messina heat-transfer surfaces are located within the chamber defined by the two parts of the manifold structure 102, 104.

For at least this reason, Messina fails to disclose the external heat-transfer surfaces of independent claims 1 and 12, as amended. Accordingly, the Messina patent cannot anticipate

independent claims 1 and 12, and claims 2-5, 10, and 13-16 that depend therefrom. Therefore, Applicant respectfully requests that the Examiner withdraw the present rejection.

Rejections Under 35 U.S.C. § 103

The Nguyen Patent and Ordinary Skill in the Art

The Examiner has rejected claims 2, 9, 11, 17, 18, 21, 23, 34, and 37 under 35 U.S.C. § 103 as being obvious in view of the Nguyen patent, discussed above. The Examiner asserts Nguyen discloses a device having all of the elements of these claims except the number of first and second manifolds, the shapes of the manifolds being triangular, and the relative volumes of the first and second manifolds. The Examiner further asserts it would have been obvious to a person having ordinary skill in the art at the time of the invention in view of the level of ordinary knowledge in the art to change the Nguyen device such that it includes the elements of the recited claims. Applicant respectfully disagrees.

Regarding claims 2, 9, 11, 21, 23, 34, and 37, these claims depend from independent claims 1, 19, 33, and 36 discussed above in connection with the anticipation rejection in view of the Nguyen patent. As discussed above, Nguyen does not disclose all the features of these claims that the Examiner asserts are present, e.g., the heat-transfer surface and a plurality of first and second manifolds. In addition, ordinary skill in the art would not suggest providing these features to the Nguyen device. Rather, combining such features with the Nguyen device could only be done in hindsight of the present invention. This type of hindsight reconstruction is not permissible in formulating an obviousness-type rejection. Therefore, the asserted combination of the Nguyen teachings with ordinary skill in the art would lack at least the heat-transfer surface and plurality of first and second manifolds limitations required by each of claims 2, 9, 11, 21, 23, 34, and 37.

Regarding claims 17 and 18, these claims, like independent claims 1, 19, 33, and 36, each require a plurality of first and second manifolds, which Nguyen does not disclose. Again, ordinary skill in the art would not suggest providing these features to the Nguyen device. Rather, combining such features with the Nguyen device could only be done in hindsight of the present invention. Therefore, the asserted combination would lack at least this feature of claims 17 and 18.

For at least the foregoing reasons, the combination of the Nguyen patent and ordinary skill in the art cannot render claims 2, 9, 11, 17, 18, 21, 23, 34, and 37 obvious. Therefore, Applicant respectfully requests that the Examiner withdraw the present rejection.

The Chu et al. Patent and Ordinary Skill in the Art

The Examiner has rejected claims 11, 17, and 18 under 35 U.S.C. § 103 as being obvious in view of the Chu et al. patent, discussed above. The Examiner asserts Chu et al. disclose a device having all of the elements of these claims except the relative volumes of the first and second manifolds. The Examiner further asserts it would have been obvious to a person having ordinary skill in the art at the time of the invention in view of the level of ordinary knowledge in the art to change the Chu et al. device such that it includes the elements of the recited claims.

Applicant respectfully disagrees.

Regarding claim 11, this claim depends from independent claim 1 discussed above in connection with the anticipation rejection in view of the Chu et al. patent. As discussed above, Chu et al. do not disclose all the features of claim 1 that the Examiner asserts are present, e.g., the recited geometric relationship between the interconnecting channels and the first and second manifolds. In addition, ordinary skill in the art would not suggest providing this feature to the Chu et al. device. Rather, suggesting that the Chu et al. device could be provided with the geometrical configuration recited in claim 1 could only be done in hindsight of the present invention. Again, this type of hindsight reconstruction is not permissible in formulating an obviousness-type rejection. Therefore, the asserted combination of the Chu et al. teachings with ordinary skill in the art would lack at least this limitation of claim 11.

Regarding claim 17 and claim 18 that depend therefrom, claim 17 has been amended to recite the same geometrical relationship among the first and second manifolds and interconnecting channels discussed immediately above in connection with claim 1. That is, claims 17 and 18 now require that both the first and second manifolds extend along the length of the core and that the interconnecting channels be spaced from one another along the length of the core. As discussed above, Chu et al. do not disclose this geometrical configuration. Moreover, ordinary skill in the art would not suggest changing the configuration of the Chu et al. device to the configuration recited in amended claim 17. Therefore, the asserted combination of the Chu

et al. teachings with ordinary skill in the art would lack at least this limitation present in each of claims 17 and 18.

For at least the foregoing reasons, Applicant asserts the present obviousness-type rejection of claims 11, 17, and 18 of the Chu et al. patent and ordinary skill in the art is improper. Therefore, Applicant respectfully requests that the Examiner withdraw this rejection.

The Messina Patent and Ordinary Skill in the Art

The Examiner has rejected claims 9, 11, 17, and 18 under 35 U.S.C. § 103 as being obvious in view of the Messina patent, discussed above. The Examiner asserts Messina discloses a device having all of the elements of these claims except the cross-sectional shape of the first and second manifolds and the relative volumes of the first and second manifolds. The Examiner further asserts it would have been obvious to a person having ordinary skill in the art at the time of the invention in view of the level of ordinary knowledge in the art to change the Messina device such that it includes the elements of the recited claims. Applicant respectfully disagrees.

Regarding claims 9 and 11, these claims depend from amended independent claim 1, discussed above in connection with the anticipation rejection in view of the Messina patent. Messina does not disclose all the features of claim 1 that the Examiner asserts, e.g., the external heat-transfer surface. In addition, ordinary skill in the art would not suggest providing this feature to the Messina device. Rather, suggesting that the Messina device could be provided with the external heat-transfer surface recited in claim 1 could only be done in hindsight of the present invention. Again, this type of hindsight reconstruction is not permissible in formulating an obviousness-type rejection. Therefore, the asserted combination of the Chu et al. teachings with ordinary skill in the art would lack at least this limitation of claims 9 and 11.

Regarding claim 17 and claim 18 that depend therefrom, claim 17 has been amended to include a heat-transfer surface located externally on the core. As discussed above, Messina does not disclose this feature. In addition, ordinary skill in the art would not suggest changing the Messina device to include the external heat-transfer surface recited in amended claim 11. Therefore, the asserted combination of the Messina teachings with ordinary skill in the art would lack at least this limitation present in each of claims 17 and 18.

For at least the foregoing reasons, Applicant asserts the present obviousness-type rejection of claims 9, 11, 17, and 18 in view of the Messina patent and ordinary skill in the art is improper. Therefore, Applicant respectfully requests that the Examiner withdraw this rejection.

The Chu et al. and Bonde et al. Patents

The Examiner has rejected claims 15, 16, 31, and 32 under 35 U.S.C. § 103 as being obvious in view of the Chu et al. patent, discussed above, and U.S. Patent No. 5,099,311 to Bonde et al. The Examiner asserts Chu et al. disclose a device having all of the elements of these claims except a fluid recirculation system. The Examiner then states that Bonde et al. disclose a fluid recirculation system and asserts it would have been obvious to a person having ordinary skill in the art at the time of the invention to use the Chu et al. device with a fluid recirculation system. Applicant respectfully disagrees.

Regarding dependent claims 15 and 31, these claims depend from independent claims 12 and 28, respectively, that as discussed above in connection with the anticipation rejection in view of the Chu et al. patent, Applicant believes are patentable over the Chu et al. device. As to claims 12 and 15, the Chu et al. device lacks at least the specific geometrical configuration of the first and second manifold and interconnecting channels of these claims. As to claims 28 and 31, the Chu et al. device lacks at least the plates stacked in a direction parallel with the first and second manifold. Moreover, these features that Chu et al. do not disclose, are not disclosed in, or suggested by, the Bonde et al. patent, ordinary skill, or any other reference of record. Therefore, claims 15 and 31 are not obvious in view of the cited combination.

Regarding independent claims 16 and 32, these claims are essentially the same as dependent claims 15 and 31 rewritten in independent form. Thus, for the reasons discussed immediately above in connection with claims 15 and 31, Applicant asserts claims 16 and 32 are likewise not obvious in view of the asserted combination.

For at least the foregoing reasons, Applicant respectfully requests that the Examiner withdraw the present obviousness-type rejection of claims 15, 16, 31, and 32 in view of the combination of the Chu et al. and Bonde et al. patents.

Other References Cited by the Examiner

Applicant has reviewed the additional references, U.S. Patent No. 5,843,385 to Dugan and U.S. Patent No. 5,005,640 to Lapinski et al., cited by the Examiner in the present Office Action. Applicant asserts that the Dugan and Lapinski et al. patents, alone and in combination with one another, ordinary skill in the art, and/or the other references of record, do not disclose or suggest the subject matter of any of claims 1-40, as amended.

CONCLUSION

In view of the foregoing, Applicant submits that claims 1-40, as amended, are in condition for allowance. Therefore, prompt issuance of a Notice of Allowance is respectfully solicited. If any issues remain, the Examiner is encouraged to call the undersigned attorney at the number listed below.

Respectfully submitted,

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Attachments

Substitute Paragraph Showing Amendment
Substitute Claims Showing Amendments

SUBSTITUTE PARAGRAPH SHOWING AMENDMENT

[0032] For example, in the exemplary embodiment of NFHX 120 for cooling a microprocessor described above with respect to FIGS. 3-5, heat exchanger plate 136 and spacer plate 138 were described as having thicknesses on the order of 0.15 mm and on the order of 0.05 mm, respectively, yielding a pitch between adjacent heat-exchanger plates on the order of 0.20 mm. To form core 130 of heat-exchanger plates 236 that has comparable dimensions, the full thickness of each plate would be on the order of 0.20 mm and the depth of recessed regions 248 would be on the order of 0.05 mm. Heat-exchanger plates 236 may be made of the same materials as described above with respect to heat-exchanger plates 136. In addition, similar aperture-forming techniques may be used to form inlet and outlet apertures 238, 240. Recessed regions 248 may be formed by coining or a material removal technique, such as chemical milling, laser ablation, micro-machining or conventional machining, among others. One skilled in the art will appreciate that the foregoing recess-forming techniques may be used on one or both sides of a plate so that a single plate may take the place of any two or more plates solely having apertures formed therein for defining a particular passageway within a stack of plates. For example, referring to FIG. 3, inlet wall plate 174, heat exchanger plate 136, and spacer plate 138 may be replaced by a single plate having recesses formed on one side corresponding to inlet apertures 180 and on the opposite side corresponding to outlet apertures 156 and combination apertures 158.

SUBSTITUTE CLAIMS SHOWING AMENDMENTS

1. (Once Amended) A heat exchanger, comprising:

- a) a core having a length, a width perpendicular to said length and a heat transfer surface extending along said length and said width and being external to said core;
- b) a plurality of first manifolds formed in said core and extending along said length;
- c) a plurality of second manifolds formed in said core and extending substantially coextensively, and located alternatingly across said width, with said plurality of first manifolds; and
- d) a plurality of interconnecting channels formed in said core and spaced from one another along said length, each of said plurality of interconnecting channels having a first end fluidly communicating with at least one of said plurality of first manifolds at a location distal from said heat transfer surface and a second end fluidly communicating with at least one of said plurality of second manifolds.

12. (Once Amended) An assembly, comprising:

- a) a heat exchanger comprising:
 - i) a core having a length, a width perpendicular to said length and a heat transfer surface extending along said length and said width and being external to said core;
 - ii) a plurality of first manifolds formed in said core and extending said length;
 - iii) a plurality of second manifolds formed in said core extending said length and located alternatingly with said plurality of first manifolds across said width; and
 - iv) a plurality of interconnecting channels formed in said core and spaced from one another along said length, each of said plurality of interconnecting channels having a first end fluidly communicating with at least one of said plurality of first manifolds at a location distal from said heat transfer surface and a second end fluidly communicating with at least one of said plurality of second manifolds; and
- c) a device in thermal communication with said heat-transfer surface.

17. (Once Amended) A heat exchanger, comprising:

- a) a core having a length, [and] a first volume, and a heat-transfer surface located externally with respect to said core;
- b) a plurality of first manifolds extending along said length and having a second volume;
- d) a plurality of second manifolds extending substantially coextensively with said plurality of first manifolds and having a third volume; and

- d) a plurality of interconnecting channels each fluidly connecting at least one of said plurality of first manifolds with at least one of said second manifolds, said plurality of interconnecting channels spaced from one another along said length of said core;
- e) wherein the sum of said second volume and said third volume is at least 20% of said first volume.

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